Implications of Increased Renewable Gases on Emissions and Stability Behavior of Appliances

OVERVIEW

Interest in utilizing fuels created from renewable resources is growing significantly throughout the world. Renewable fuels include those generated from waste streams such as landfills, biomass, or waste water treatment. Alternatively, excess renewable electricity can be used to generate hydrogen via electrolysis of water (e.g. an “Electrofuel”). An attractive strategy for incorporating these fuels is to blend them into the existing natural gas infrastructure. As a result, the question arises as to how these blends might impact the performance of end use devices in terms of emissions, efficiency, and safety. The past few decades have witnessed plentiful and substantial achievements of advanced combustion techniques in industry, and CO, SO_X, and NO_X, emissions produced in industry have dropped significantly. However, less research has been conducted to investigate the performance of commercial and residential appliances.

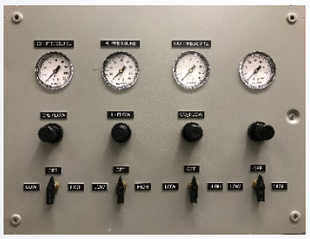
GOALS

The major task of this project is to test the combustion performance of different appliances utilizing renewable natural gas. Both experimental and simulation methods will be adopted to analyze the stability, fuel consumption, heating performance, and emissions of different appliances. This research will help evaluate the feasibility of replacing natural gas with alternative fuels in commercial and residential appliances.

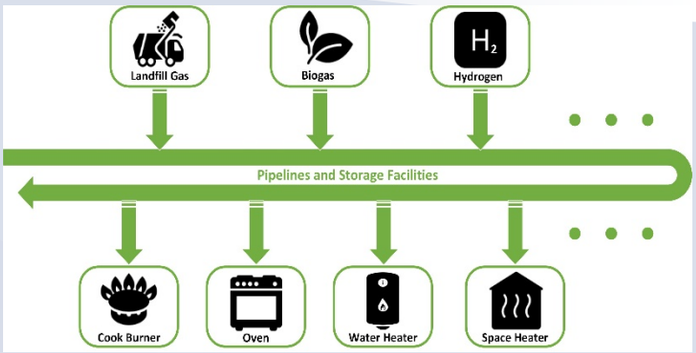
RESULTS

A fuel-mixing device was built to add renewable gases to natural gas. The percentage of different fuels in the mixture can be changed by adjusting the regulators on the control panel. Being tested in the experiments are a cooktop burner, broiler, oven burner, space heater, and water heater.
Computational Fluid Dynamics (CFD) will be utilized to compare the simulation results and experiment results. For example, a 3D model was developed to simulate the cooktop burner.

Cooktop Burner



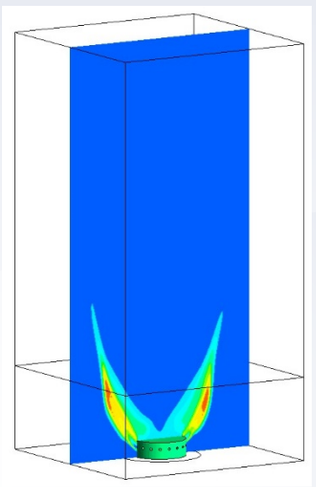
Fuel-mixing Control Panel



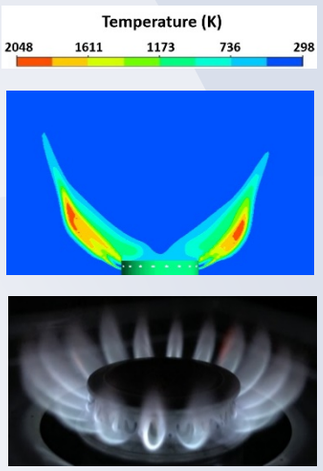
Schematic of the Introduction and Use of Renewable Fuels

FUTURE WORK

Ignition performance, and CO/NO_X emissions of different appliances utilizing different fuel mixtures are being tested in the experiments, and will provide validation data for the simulation methodology. Verified simulation methodology will then be applied to predict combustion performance for more appliances. Finally, the impacts of renewable fuel composition on combustion performance will be determined.



3D Cooktop Burner Model



Comparison Between Simulation and Experiment

PERSONNEL

Graduate Students: Yan Zhao, Shiny Choudhury
Undergraduate Student: Leslie Hsiao
Staff: Max Venaas
Principal Investigator: Professor Vince McDonell
Advanced Power and Energy Program
University of California, Irvine

Project Sponsor: **California Energy Commission**

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